(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
22 January 2004 (22.01.2004)

PCT

(10) International Publication Number
WO 2004/007051 A1

(51) International Patent Classification[7]: B01D 35/00

(21) International Application Number:
PCT/IN2002/000149

(22) International Filing Date: 11 July 2002 (11.07.2002)

(25) Filing Language: English

(26) Publication Language: English

(71) Applicant (*for all designated States except US*): GEA ENERGY SYSTEM (INDIA) LTD [IN/IN]; 443, Anna Salai, Teynampet, Chennai 600 018, Tamil Nadu (IN).

(72) Inventor; and

(75) Inventor/Applicant (*for US only*): BALAKRISHNAN GOVINDASAMY, Raghupathy [IN/IN]; 100, IV Street, Abiramapurm, Chennai 600 018, Tamil Nadu (IN).

(74) Agents: DEPENNING RG et al.; Depenning & Depenning, 31 South Bank Road, Chennai 600 028, Tamil Nadu (IN).

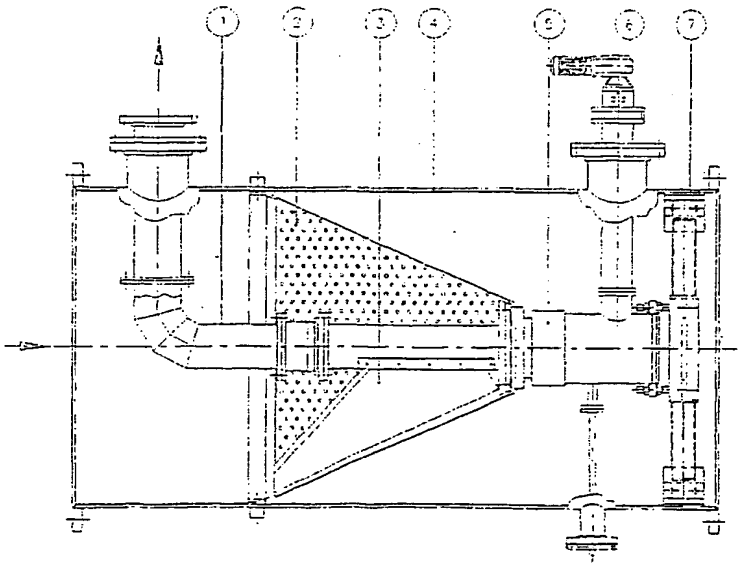
(81) Designated States (*national*): AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NO, NZ, OM, PH, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VN, YU, ZA, ZM, ZW.

(84) Designated States (*regional*): ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE, SK, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:
— *with international search report*

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(54) Title: A DEBRIS FILTER WITH A ROTATING DEBRIS EXTRACTOR



(57) Abstract: A filter for filtering solid particles from liquids, especially for use in steam condensers and heat exchanger in thermal and nuclear power plants, said filter comprising a housing (4), a screen basket (2) located within said housing (4), a debris discharge pipe (1) for discharging accumulated and captured debris; a debris extractor arm (3) with a curvature towards the screen extending outwards at a predetermined radius with respective vertical plane, the said debris extractor arm (3) being rotatably driven over the entire length of the screen to create a low pressure between the debris extractor arm (3) and the screen (4) for complete extraction of debris and conveying to said debris discharge pipe (1).

WO 2004/007051 A1

A DEBRIS FILTER WITH A ROTATING DEBRIS EXTRACTOR

FIELD OF INVENTION

This invention relates to a debris filter with rotating debris extractor. In particular, this invention is concerned with a debris extractor. Further, this invention provides a system and a method, of removal of debris from filter screen.

BACKGROUND OF THE INVENTION

It is well known in the art that thermal and nuclear power plants use steam condensers for condensation of steam after the energy has been utilized to drive the turbine. The steam condensers known in the art may be either water-cooled or air-cooled. In water-cooled process, water is typically obtained from sources like sea, rivers and lakes. The quantity of water required is quite large and it contains debris like grass, shells, fish, cloth and plastic sheet. These debris tend to clog the tubes of the steam condensers causing reduction in heat transfer which in turn may affect power generation. The problem of accumulation of debris and need for periodic removal of debris posses a serious challenge to the power generating plants. To over come this problem an automatic debris filter is installed at the inlet of the condenser, which filters and removes out such suspended particles. The automatic debris filters of the conventional type uses different techniques for removing debris and there is scope for further improvement in this area. In one such conventional debris filter a tubular housing and a screen basket is provided, the said screen basket is

fastened to the inner periphery of housing. In the general arrangement of debris filter, a debris extraction arm is mounted on the inlet side of the basket and is rotatable with respect to the screen and on its complete surface area. The disadvantages faced by using this filter is that the sealing lips near the location where the suction arm closes a segment of the screen to create back wash, wears off and thereby back wash effect reduces time to time. Further the debris coming between the seal and suction arm obstructs the smooth rotation of the suction arm. Also, since one segment of the screen is completely closed by the suction arm, the screen area available for filtration gets reduced.

For dislodging and removing debris clogged on the screen suction arms, which completely closes a segment of the screen and is rotatable to cover the complete screen, another method was adopted in the prior art is to use a debris filter with a rotatable suction arm inside the basket arm along with a jet water spray arrangement positioned outside the screen. In this debris filter the profile of the debris extractor does not facilitate removal of sticky debris from the screen easily. Hence, an additional water spray pump which delivers water at a velocity more than the inlet velocity of water from the clean side of filter is required to reverse the sticky debris from the screen. This arrangement results in additional power consumption for the water spray pump and also makes it more expensive.

The object of the invention is to provide a novel debris filter with a rotating debris extractor, which overcome the abovementioned disadvantages in the conventional debris extractors.

DISCLOSURE OF THE INVENTION

The invention provides a filter for filtering solid particles from liquids, especially for use in steam condensers and heat exchanger in thermal and nuclear power plants, said filter comprising a housing, a screen basket located within said housing, a debris discharge pipe for discharging accumulated and captured debris; a debris extractor arm with a curvature towards the screen extending outwards at a predetermined radius with respective vertical plane, the said debris extractor arm being rotatably driven over the entire length of the screen to create a low pressure between the debris extractor arm and the screen for complete extraction of debris and conveying to said debris discharge pipe.

BRIEF DESCRIPTION OF THE INVENTION

The debris filter for removing solid particles from liquid according to the invention comprises a tubular housing, a screen basket fastened to the inner periphery of said housing, a debris discharge pipe to discharge the accumulated and captured debris and a debris extractor having a unique arm designed for maximum efficiency. The said debris extractor arm is rotated at a low speed so as to enable the complete filtering of the liquid.

The profile of the debris extractor arm provides a suction effect right through the arm. That is to say the suction is created on the entire length of arm. The debris extractor arm has a specially designed profile with a curvature towards the screen extending outwards at a predetermined radius with respect to vertical plane. This profile causes a lower pressure between the screen and the extractor compared to pressure elsewhere in

the screen. This feature ensures that the debris on the screen is lifted from the screen and channeled through the extractor to the outlet. The modified design of debris extractor of the present invention overcome the constraints of the debris filter known in the prior art, resulting in higher efficiency and better performance of the debris filter.

Another object of the invention is to provide a debris filter which has unique extraction means which results in effective debris removal.

Yet another object of the invention is to provide a debris filter with debris extractor which does not disturb the smooth rotation of debris extraction arm.

A further object of the invention is to provide a sturdy debris filter with a debris extractor which is efficient, economical and avoid the need for a water jet spray arrangement to clean the inside of the basket.

DESCRIPTION OF THE DRAWINGS

Further features and other objects and advantages of this invention will become clear from the following detailed descriptions made with reference to the accompanying drawings, in which,

Figure 1: shows a longitudinal cross-section of the debris filter with a rotating debris extractor according to the present invention.
Figure 2: shows a cross-sectional view of the debris filter according to the invention.
Figure 3: shows the detailed view of the portion indicated by A in Fig 2.

Figure 4: shows the debris arm extractor.

Figure 5: shows a sectional view along A-A of the debris arm extractor shown in Fig 4.

Figure 6: shows a detail view of B indicated in Fig 5.

Figure 7: shows a cooling system incorporating the debris filter according to the present invention.

DETAIL DESCRIPTION.

The debris filter according to the invention comprises a screen basket (2) which captures the debris, a debris discharge pipe (1), to discharge the accumulated and captured debris, a debris extractor arm (3) for removing debris from the screen basket (2), all housed in a tubular housing (4). Then the debris extractor arm (3) is rotated at low speed preferably using geared motor drive (6). A special gear train may be incorporated in the gear box housing (5) to enable high torque at minimum speed. The gear box housing (5) and gear box sealing support (7) are housed in a housing (4) and the debris extractor arm (3) is rotated by a motor drive (6).

The debris extractor arm (3) does not come in contact with screen but at the same time produces an effective extraction of debris from the screen basket (2). In addition, it eliminates the problems in the debris separators known in the art and avoids use of a prevalent special water spray pump. This is achieved by a unique profile of the debris extractor arm with a curvature towards the screen extending outwards at a predetermined radius with respective vertical plane which creates a low pressure between the debris extractor arm and screen compared to pressure elsewhere inside the tubular housing (4). This low pressure results in

effective extraction of debris, which is then conveyed to debris discharge line. This distance between the screen basket (2) and debris extractor arm (3) can be varied to suit the size of debris achieving more effective debris removal and ensures that the encountered debris does not disturb the rotation of the debris extractor arm (3).

The debris filter automatically removes all types of coarse matter from the liquid. The debris filter is normally installed as close as possible upstream of the heat transfer equipment. Essentially, filtration is achieved by a conical screen basket. The cooling water conditions dictate the size and type of perforation. Preferably, the perforation size may be in the range of 0.5mm to 10mm.

A debris extractor arm is located on the inside of the screen basket to collect the dislodged debris. This debris extractor arm rotates over the whole length of the conical screen and is driven by a low speed motor. The debris collected through the debris extractor arm is moved through a debris discharge pipe to the cooling water outlet along with a small percentage of cooling water. The flushing of the debris from the debris filter is carried out automatically either after a preset time or when the pressure drop exceed the preset value. Flushing cycle normally does not exceed 3 minutes and it is adjusted to suit the site condition. The debris filter operates at inlet flow velocities up to 4 meters per second and offers a low head loss. The debris filter according to the invention may be made to suit customer requirements particularly adapting to the space available at site and the pressure loss criteria.

The invention has various applications. A specific application of the device is as an energy saving system. The object of energy saving system has unique implication in the improvement of heat transfer in condensers and heat exchangers used in power plants and process plants. The placement of debris filter in the energy saving system is illustrated in fig.5 of the drawings. The plant comprises an outlet (8) and inlet (9) for cold water, a debris outlet valve (10), a debris output pipe (11) and a condenser (12). Such a plant facilitate removal of debris completely which results in augmenting efficiency of the plant.

It is to be noted that the object of the description is to explain the salient features of the invention. It is to be further noted that within the scope and ambit of the invention various amendments or modification are possible. An embodiment of the invention for which the scope of the invention is defined in the following statement of claims.

CLAIMS :

1. A filter for filtering solid particles from liquids, especially for use in steam condensers and heat exchanger in thermal and nuclear power plants, said filter comprising a housing (4), a screen basket (2) located within said housing (4), a debris discharge pipe (1) for discharging accumulated and captured debris; a debris extractor arm (3) with a curvature towards the screen extending outwards at a predetermined radius with respective vertical plane, the said debris extractor arm (3) being rotatably driven over the entire length of the screen to create a low pressure between the debris extractor arm (3) and the screen (4) for complete extraction of debris and conveying to said debris discharge pipe (1).

2. The filter as claimed in claim 1, wherein the said debris extractor arm (3) is provided with a drive for driving over the entire length of the screen.

3. The filter as claimed in claim 2, wherein the drive is a geared motor drive (5, 6).

4. The filter as claimed in any one of the preceding claims, comprising means for adjusting the distance between said screen basket (4) and debris extractor arm (3).

5. The filter as claimed in claim 1, wherein the end of debris extractor arm close to the screen is provided with a curvature to avoid contact with the screen.

6. The filter as claimed in claim 1, wherein said screen basket (4) has a conical shape.

7. A cooling system comprising an inlet (9) and an outlet (8) for cooling water, a debris filter comprising a housing (4), a screen basket (2) located within said housing (4), a debris discharge pipe (1) for discharging accumulated and captured debris; a debris extractor arm (3) with a curvature towards the screen extending outwards at a predetermined radius with respective vertical plane, the said debris extractor arm (3) being rotatably driven over the entire length of the screen to create a low pressure between the debris extractor arm (3) and the screen (4) for complete extraction of debris and conveying to said debris discharge pipe (1), a debris outlet valve (10), a debris output pipe (11) and a condenser (12) for heat transfer.

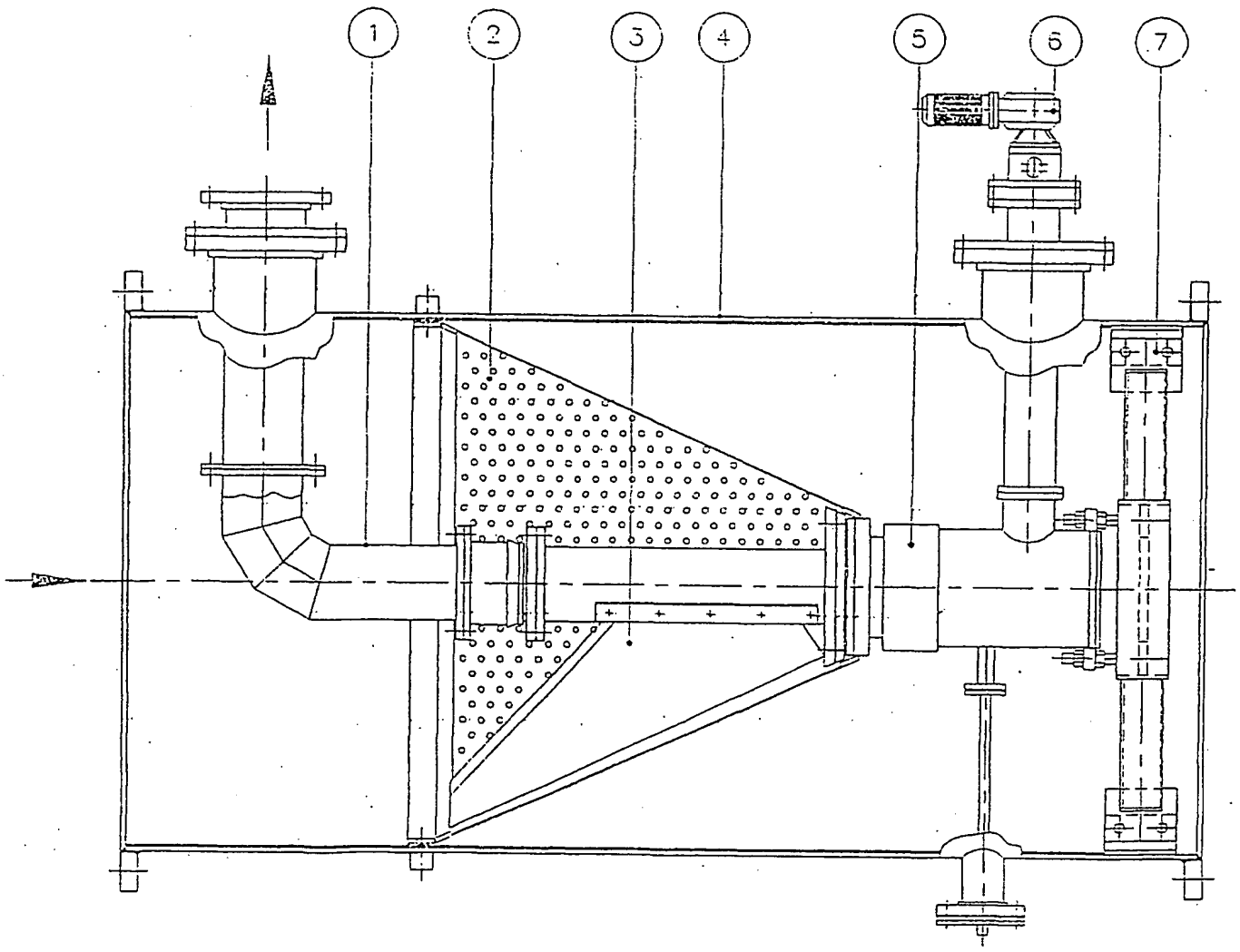


FIG.1

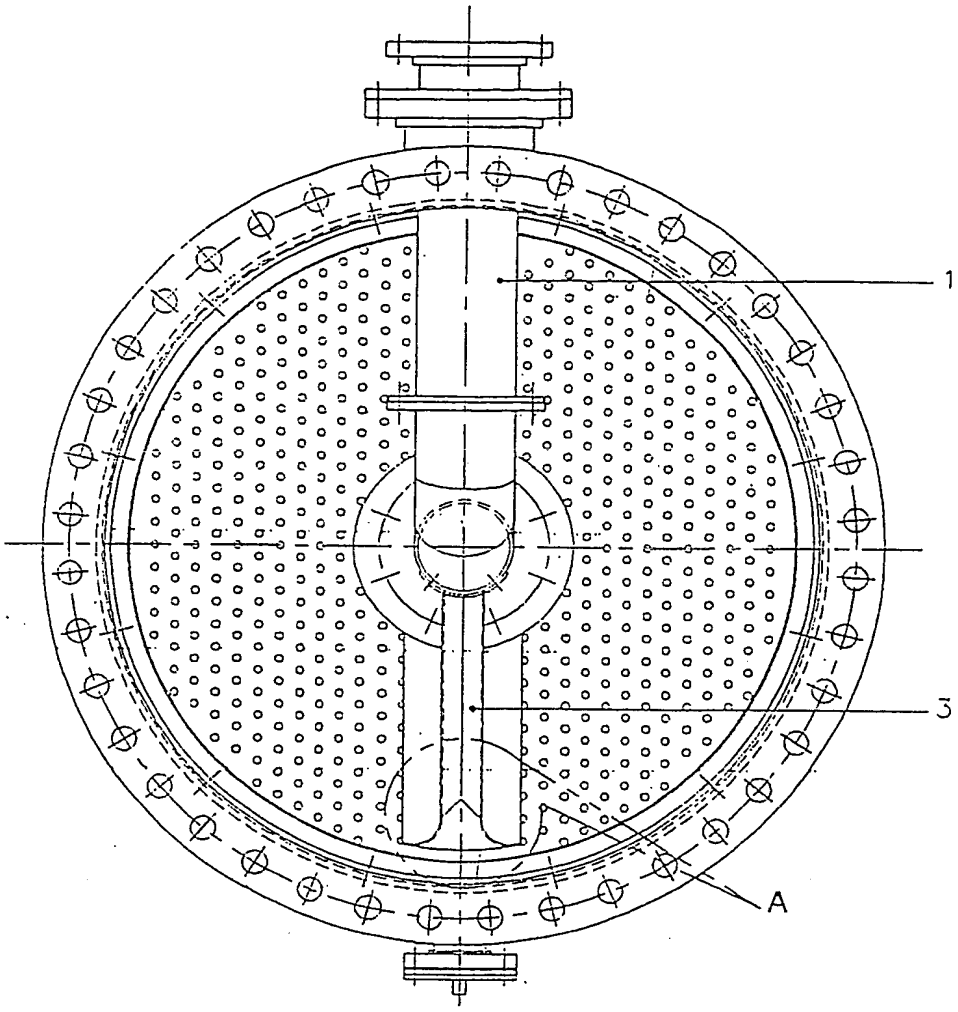


FIG.2

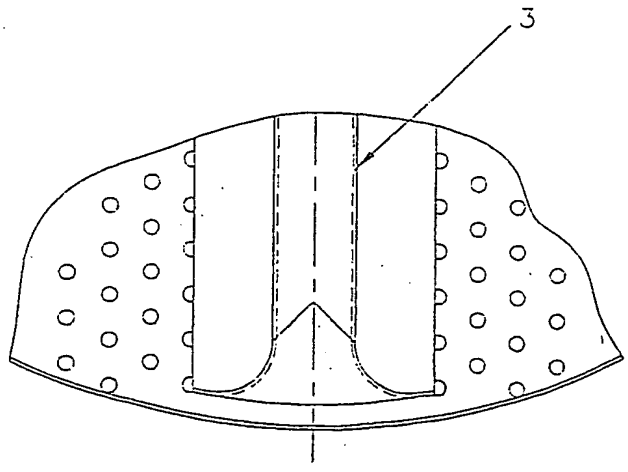


FIG.3

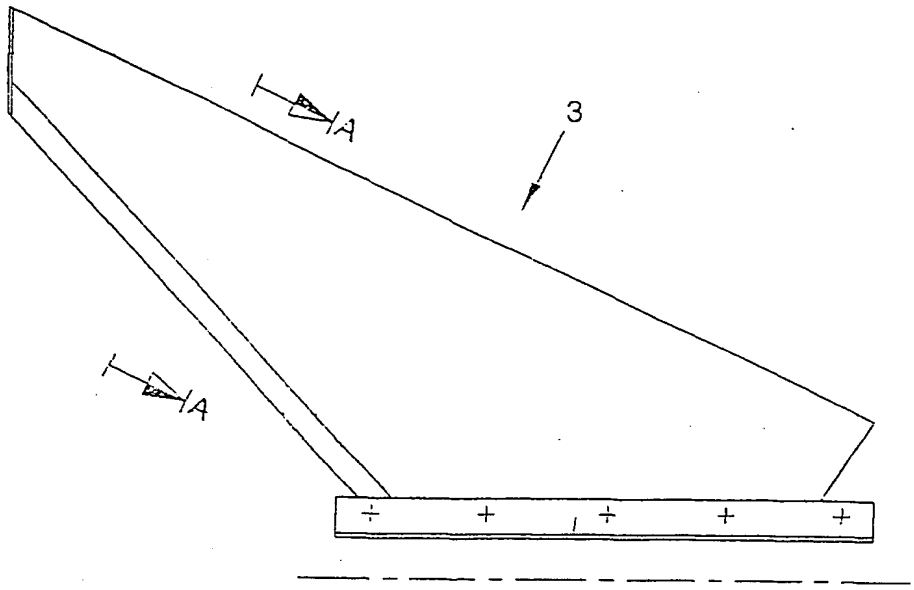


FIG.4

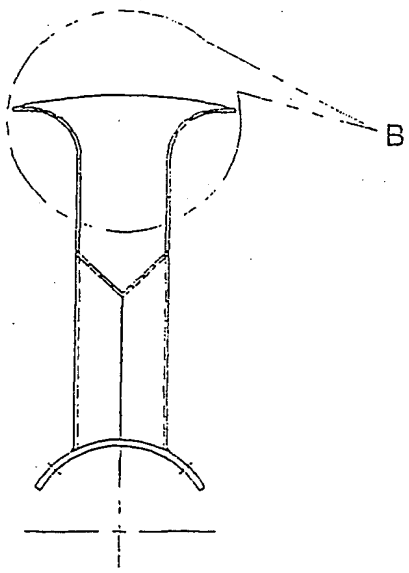


FIG.5

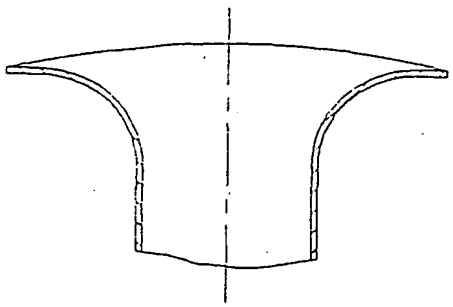


FIG.6

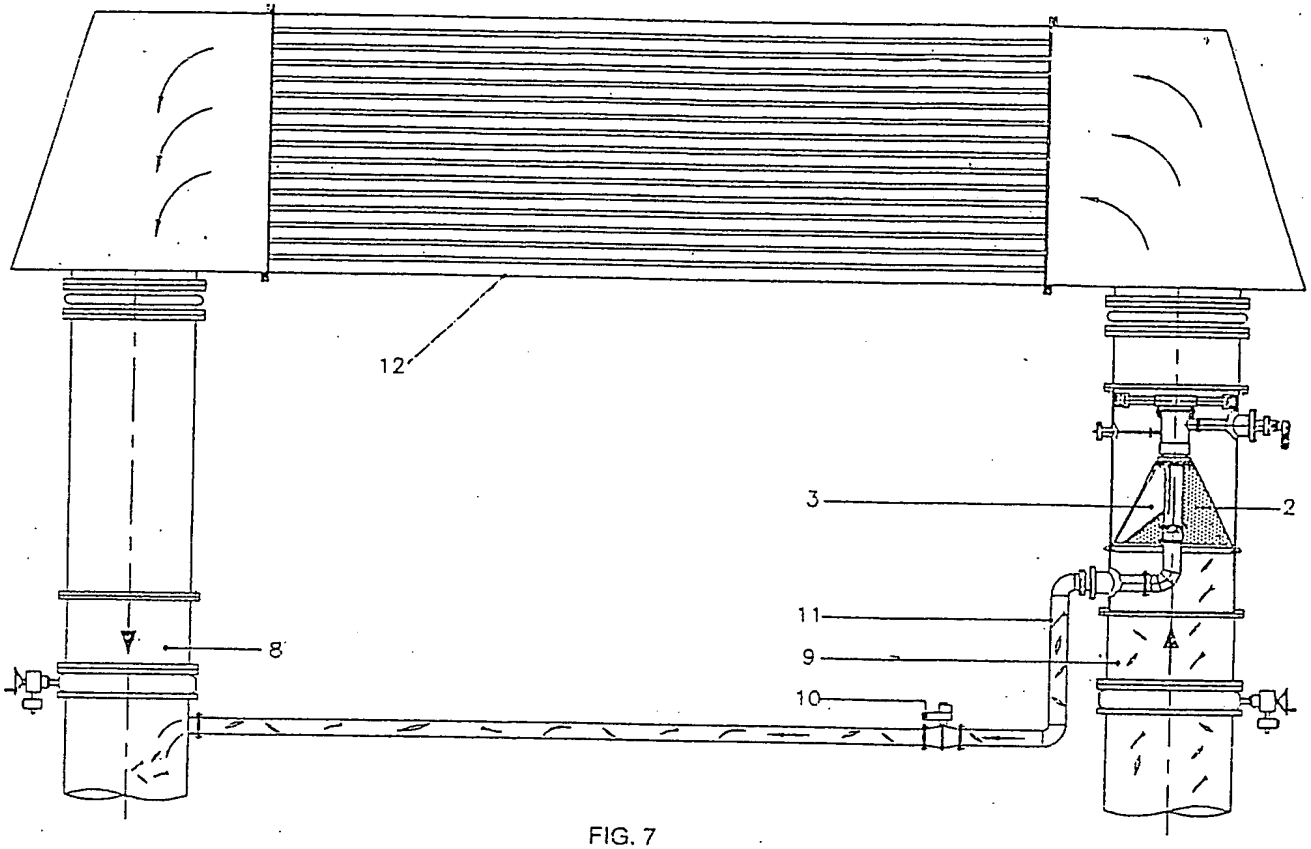


FIG. 7